

- (57) A bumper assembly comprising a bumper reinforcing member (1), a recess (R) being provided in this member a shock absorbing member (2) of resilient material and a bumper skin (3), in which the shock absorbing member is received into the recess to a depth of 20% to 35% of the thickness of the shock absorbing member in the unstressed state. With this construction, a bumper assembly of reduced thickness is obtained which is light and strong but does not result in reduced performance of the shock absorbing member.



FIG.1
(PRIOR ART)

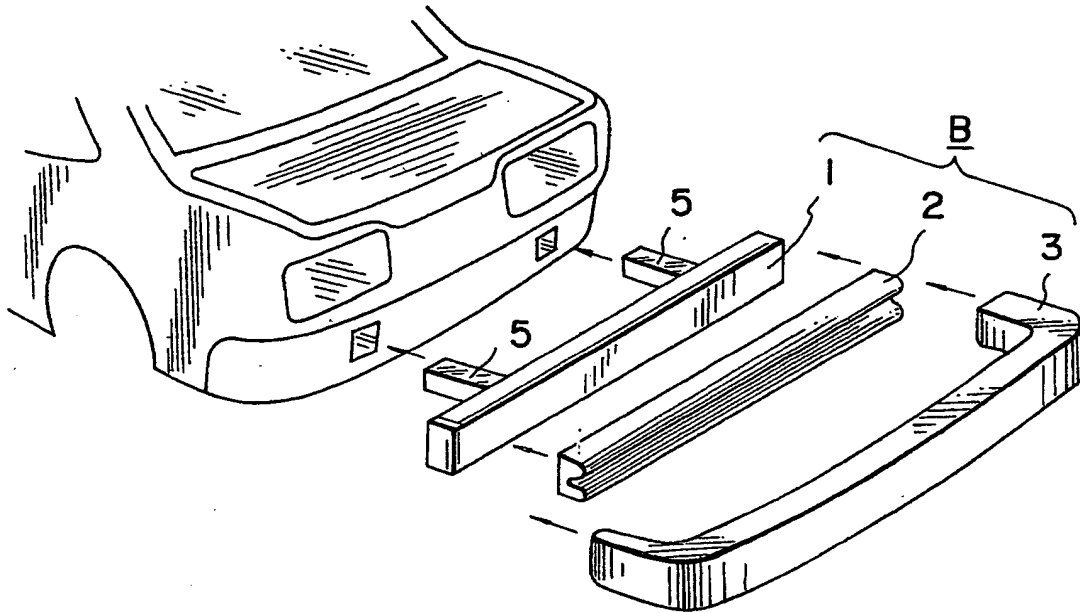


FIG.2
(PRIOR ART)

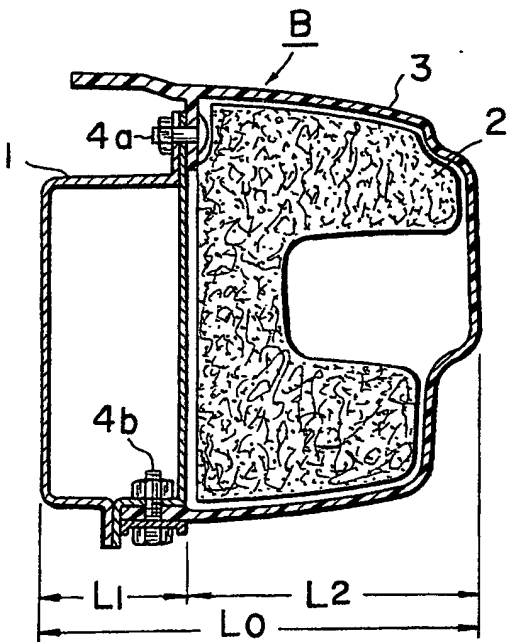
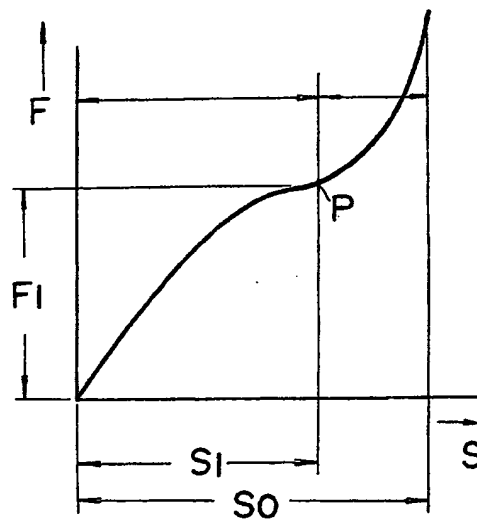


FIG.3



2/3

FIG. 4

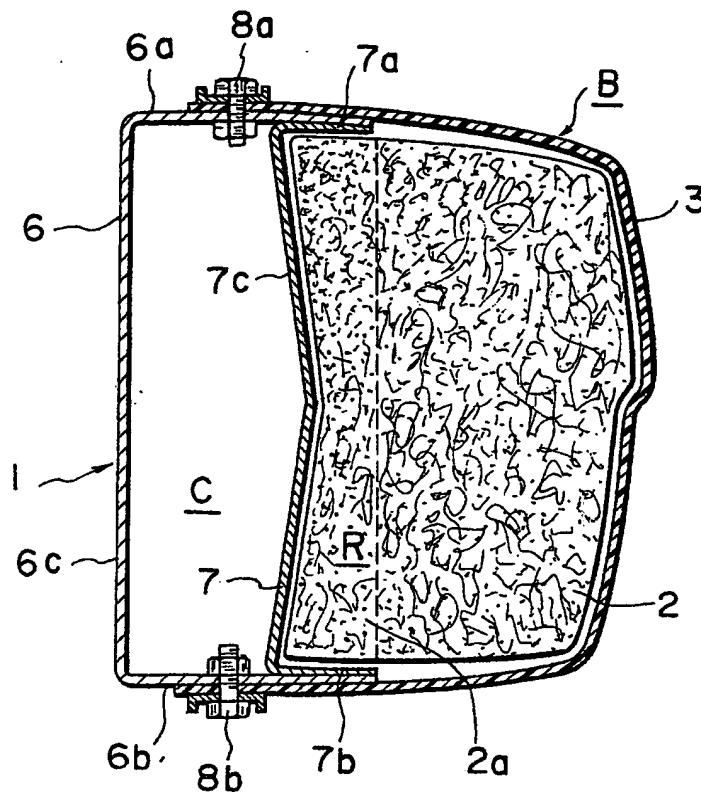


FIG. 5

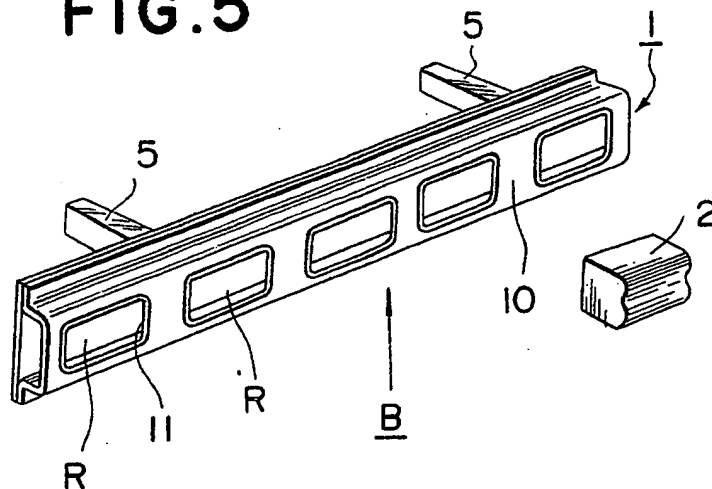


FIG. 6

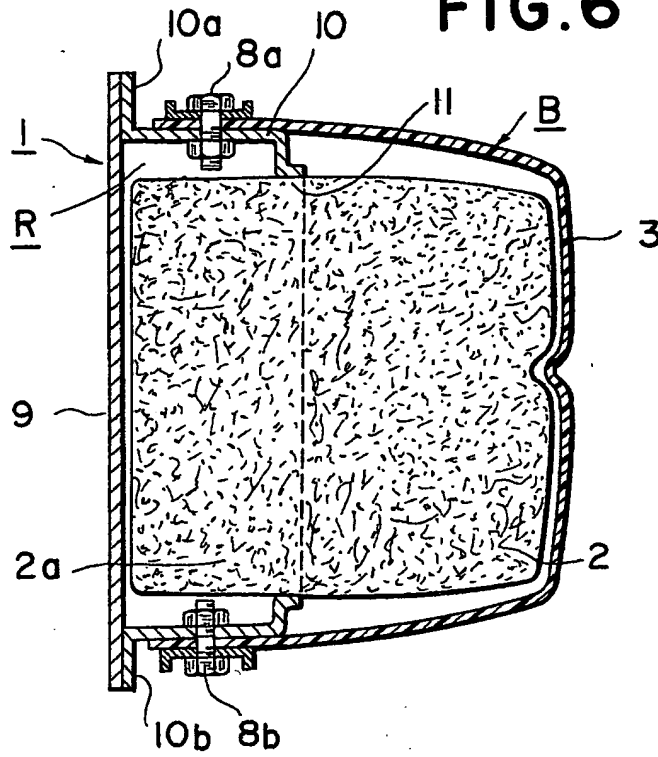
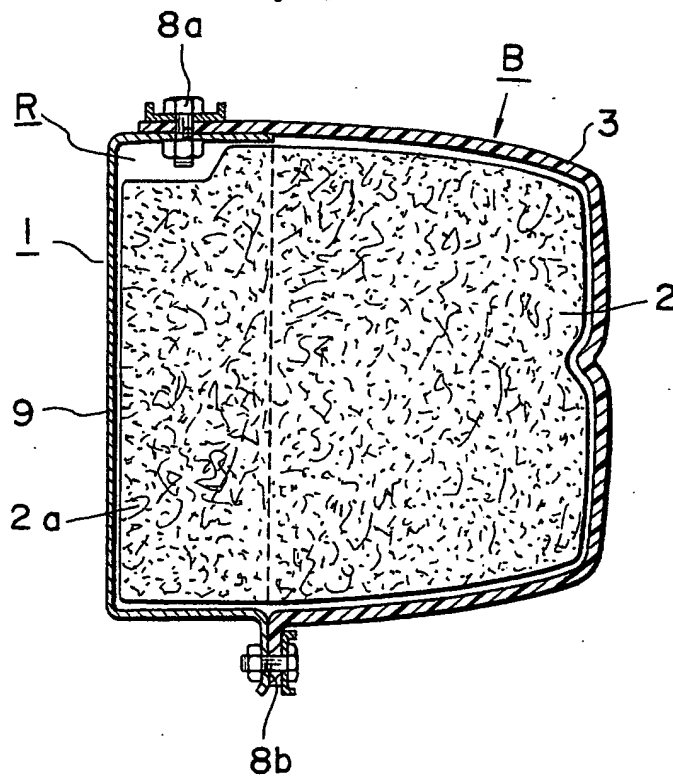


FIG. 7



SPECIFICATION

Bumper structure

5 The present invention relates to a bumper structure, and particularly to a bumper assembly having a shock absorbing member formed of synthetic resin or rubber and arranged in the front of a metal bumper reinforcing member in which the shock
10 energy at the time of a collision can be absorbed by the deformation of the shock absorbing member.

A conventional bumper, shown by B in Figures 1 and 2, is provided with a shock absorbing member 2 molded out of urethane foam or polyethylene honeycomb and arranged in front of a bumper reinforcing member 1 of substantially rectangular cross-section which is made of a rigid metal. A bumper skin 3, which is also made of synthetic resin or rubber and which is capable of deforming with the
20 shock absorbing member, is bolted at 4a, 4b to the bumper reinforcing member 1 so as to cover the shock absorbing member 2. The bumper assembly is mounted on a car body by a pair of stays 5 which are provided at the back of the bumper reinforcing
25 member 1.

With this construction, the total thickness L_0 of the bumper B is the sum of the thickness L_1 of the bumper reinforcing member 1 and the thickness L_2 of the shock absorbing member 2.

30 However, in order that the bumper reinforcing member 1 has sufficient rigidity and strength a certain thickness L_1 of the member 1 is required, and on the other hand, in order that the member 2 has a shock absorption performance of at least a predetermined level, the thickness L_2 must be above a predetermined value. The conventional bumper B, therefore, must have a total thickness L_0 which is relatively deep, thus making an excessively clumsy projection when mounted on the car body.

40 Meanwhile, when the shock energy absorption characteristic of a substantially rectangular cross-sectional shock absorbing member, formed from urethane foam or polyethylene honeycomb, which has a thickness of S_0 in the free state is considered,
45 the relation between the amount of deformation S of the shock absorbing member in the direction in which shock is applied thereto and the reaction force F produced in the absorbing member on collision is shown in Figure 3, where a point of inflection P (S_1 , F_1) exists. Namely, the reaction force produced in the absorbing member sharply increases beyond the inflection point P and the absorption efficiency of the shock absorbing member deteriorates. In addition, it is confirmed from experiments that the inflection
55 point P is normally in the vicinity of 65% to 80% of the free thickness S_0 . It has been found that accordingly, the range in which the shock absorbing member can effectively be used is 65% to 80% of the free thickness S_0 and the remaining 35% to 20% is
60 not required to project from the front of the bumper reinforcing member.

It is, therefore, an object of the present invention to provide an improved bumper assembly in which the above problems encountered with the prior art
65 are solved.

It is another object of the present invention to provide an improved bumper assembly in which the total thickness of the bumper is reduced without degrading the performance of the shock absorbing member and without impairing the strength and rigidity of the bumper reinforcing member, or adding extra weight.

70 It is still another object of the present invention to provide an improved bumper assembly in which the shock absorbing member is prevented from being displaced or detached from the vehicle at the time of a collision, thereby improving the shock absorption.

In accordance with the present invention, there is provided a bumper assembly for a motor vehicle
75 comprising a bumper reinforcing member in which is formed a recess, and a shock absorbing member of a resilient material of which a portion is received in the recess.

In the accompanying drawings:-

85 *Figure 1* is an exploded view of a bumper according to the prior art;

Figure 2 is a cross-sectional view of the bumper shown in Figure 1;

Figure 3 is a characteristic curve of the relation
90 between the deformation S of the shock absorbing member and the reaction force F produced therein when the member is subjected to a shock compression force;

Figure 4 is a cross-sectional view of a preferred embodiment of a bumper assembly according to the present invention, extending substantially the whole width of a car body;

Figure 5 is a perspective view of another embodiment of the bumper assembly according to the
100 present invention; and

Figure 6 is a cross-sectional view of the Figure 5 embodiment of the present invention, further including a bumper skin attached to the bumper reinforcing member; and

105 *Figure 7* is a cross-sectional view of another embodiment of the bumper assembly according to the present invention, extending substantially the whole width of a car body.

110 *Preferred embodiment of the invention*

Throughout the Figures of the drawings, the same reference numerals denote corresponding parts.

Figure 4 shows one embodiment of a bumper assembly B according to the present invention. The
115 assembly B comprises a bumper reinforcing member 1 and a shock absorbing member 2. At one side of the bumper reinforcing member 1 is formed a recess R in which a portion 2a of the shock absorbing member 2, molded out of urethane foam or
120 polyethylene honeycomb, is embedded or received.

The bumper reinforcing member 1 comprises a first U channel member 6 and a second U channel member 7 made of a metal of high rigidity such as a high-tension steel, the second channel member 7 being appreciably shallower than the first channel member 6 and being fitted within the first channel member 6 so that both channel members face outward from the car body, with the upper side walls 6a, 7a and the lower side walls 6b, 7b of the first and
125 second members 6, 7 meeting at their edges and
130

being welded to each other. Because the second channel member 7 is shallower than the first channel member 6, a space C is formed between the bottom wall 6c of the first member 6 and the bottom wall 7c of the second member 7. With this construction, the bumper reinforcing member 1 is improved in rigidity while both upper and lower side walls 6a and 6b of the channel member 6 are sufficiently wide, and thus the bumper reinforcing member 1 has the same strength and rigidity as a prior art member.

The recess R in which the base portion 2a of the shock absorbing member 2 is received is formed over the whole length of the second channel member 7, and the depth of the recess R is determined on the basis of the experimental results which show that 20% to 35% of the unstressed or free thickness So of the shock absorbing member 2 in the direction in which shock is applied thereto can be embedded or received within the bumper reinforcing member 1; in this particular embodiment the depth of the recess R is approximately 20% of the free thickness So. The shock absorbing member 2 extends substantially the whole length of the recess R.

A bumper skin 3 covers the shock absorbing member 2 and is bolted at 8a, 8b to the upper wall 6a and lower wall 6b of the first channel member 6. The bumper skin 3 is formed of a resilient material such as synthetic resin, or rubber which is deformable along with the deformation of the shock absorbing member 2.

The bumper B thus formed is mounted on the car body by stays which are mounted at the back of the absorbing member.

Figures 5 and 6 show a second embodiment of the present invention. In this embodiment, the bumper B includes a plurality of recesses R disposed along its length at the front of the bumper reinforcing member 1. A corresponding number of shock absorbing members 2 in block form are received therein.

In this case the bumper reinforcing member 1 is of a box construction, and comprises a flat plate 9 and a flanged U channel member 10. The channel member 10 is disposed on the opposite side of the flat plate 9 from the vehicle, with the open side facing toward the vehicle. Top and bottom flanges 10a, 10b of the channel member 10 are welded to the flat plate 9. A plurality of rectangular holes 11 are formed along the length of the channel member 10 in its bottom wall, each hole forming a separate recess R. The base portion 2a of each shock absorbing member 2 is received in a corresponding recess R. In this embodiment, the depth of the base portion 2a to be received in the recess R is about 30% of the free thickness So of the shock absorbing member 2.

Next, a further embodiment of the present invention shown in Figure 7 will be described. In this embodiment, the bumper reinforcing member 1 comprises simply a U channel member facing outward and the whole opening thereof is used as a recess R accommodating the base portion 2a of the shock absorbing member 2. Thus, it is necessary that the bumper reinforcing member 1 should be made of a material of high strength and high rigidity, or from thicker material. In the particular embodiment, the thickness of the base portion 2a is roughly 35%

of So. In the particular embodiment, the shock absorbing member 2 is shown as a single piece which extends substantially the whole length of the recess, but may be replaced by a plurality of shock absorbing members in block form such as shown in Figure 5.

As described above, according to the present invention, the total thickness of the shock absorbing bumper is reduced without impairing its performance or reducing the strength and rigidity of the bumper reinforcing member. Even so, the bumper member may still be of relatively light construction.

Moreover, since the shock absorbing member is received in the recess, the shock absorbing member is prevented from becoming detached or displaced in a collision, thus improving the performance of the bumper assembly.

While the foregoing embodiments have been described as using a molded body of urethane foam or polyethylene honeycomb as a shock absorbing member, it should be noted that they are not limited to these materials, but may also be of any material which absorbs shock energy in a collision.

It is also to be noted that recess formed in the bumper reinforcing member is not limited to the configurations described in the foregoing embodiments, but may be of any structure which does not impair the strength and rigidity of the bumper reinforcing member.

CLAIMS

1. A bumper assembly for a motor vehicle comprising a bumper reinforcing member in which is formed a recess, and a shock absorbing member of a resilient material of which a portion is received in the recess.

2. The bumper assembly as claimed in claim 1 in which the thickness to which the shock absorbing member is received in the recess is in the range of 20% to 35% of the thickness of the shock absorbing member in the unstressed state.

3. The bumper assembly as claimed in claim 1, further comprising a bumper skin of a resilient material which substantially covers the shock absorbing member.

4. The bumper assembly as claimed in any of claims 1 to 3 in which the bumper reinforcing member comprises first and second U channel members, the second channel member being substantially shallower than the first channel member, the second channel member being nested within the first channel member with both U channels facing in the same direction, the two channel members being fastened together, and the recess being formed by the inside of the second channel member.

5. The bumper assembly as claimed in any of claims 1 to 3 in which the bumper reinforcing member comprises substantially a single U channel member, in which the recess is formed by the inside of the U channel member.

6. The bumper assembly as claimed in any of claims 1 to 3 in which the shock absorbing member is formed of urethane foam.

7. The bumper assembly as claimed in any of

claims 1 to 3 in which the shock absorbing member is formed of polyethylene honeycomb.

8. A bumper assembly for a motor vehicle comprising a bumper reinforcing member in which a plurality of recesses are arranged along the length of the bumper reinforcing member, and a plurality of shock absorbing members of a resilient material, a portion of each of the shock absorbing members being received in a corresponding recess.
9. The bumper assembly as claimed in claim 8, in which the bumper reinforcing member is of a box construction, and in which the plurality of recesses are formed by apertures provided in one side of the bumper reinforcing member.
10. The bumper assembly as claimed in claim 8 or 9, in which the shock absorbing members are received in the recesses to a depth of 20% to 35% of the thickness of the shock absorbing members in the unstressed state.
11. The bumper assembly as claimed in claim 10, in which the bumper reinforcing member includes a single substantially U channel member, in which the recesses are formed by the inside of the U channel member.
12. The bumper assembly as claimed in claim 10, in which each of the shock absorbing members is formed of urethane foam.
13. The bumper assembly as claimed in claim 10, in which each of the shock absorbing members is formed of polyethylene honeycomb.
14. A bumper assembly for a motor vehicle substantially as described with reference to, and as illustrated in Figure 4, or Figures 5 and 6, or Figure 7 of the accompanying drawings.

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A bumper assembly for a motor vehicle has a shell 5 supported by support means providing a progressively increasing force on impact. The shell 5 contains layers of plastics foam 8,9 of different densities. Displacement of the shell 5 relative to a body part 7 in response to the impact causes progressive resistance by the foam layers, firstly that of lighter density 8 and subsequently that of heavier density 9 to progressively decelerate the shell. The shell 5 is mounted on the body 7 through pin and slot linkages 12, 13, 14 (Fig 2), which resist initial displacement of the shell 5.

Alternatively, the initial displacement of the shell may be resisted by friction dampers, springs and air bags. Following an impact with a pedestrian the shell 5 may be displaced and/or deformed to present an inclined facia by which the pedestrian is directed upwardly.